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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE CLEVELAND MEETING

By Dr. F. R. MOULTON

PERMANENT SECRETARY

IN November, 1942, shortly after the Allied forces had landed in Africa, the association canceled the meeting that had been scheduled to be held in New York during the last days of December and the first days of January. At the time the New York meeting was canceled the program was being set in type and the association had spent more than $3,000 in preparation for it.

The postponement of the New York meeting was made in compliance with a circular letter received from the Office of Defense Transportation and requests made at a conference with its representatives. Although the ODT had no power to compel the cancelation of the meeting, the officers of the association felt it to be their duty to comply with the request of an agency of the Government under the conditions that then existed. In continuation of that policy no meeting was scheduled for 1943. In a second "release," dated July 15, 1943, the ODT stated: "Each organization must make its own independent decisions. The Office of Defense Transportation cannot pass upon the essentiality of any proposed meeting. It can only emphasize the serious burdens which convention and group-meeting travel imposes on transportation and request voluntary action by those who have it in their power to eliminate such travel." The association had long before decided to hold no meeting during 1943.

Although the association and the affiliated societies that usually meet with it uncomplainingly refrained

from holding meetings in 1942 and 1943, it was realized clearly that in doing so the advancement of science was being retarded, especially in those fields which were not of great direct importance in the war efforts of this country. In order to consider jointly what policies would be most advantageous to our country and to science, the association organized and underwrote the expenses of a conference of secretaries of the sections and of the affiliated societies in New York City on September 25, 1943. This conference, attended by 17 secretaries and officers of the association, was limited, in order to reduce railway travel, to those living within easy reach of New York. The only action of this very successful meeting relevant to the matter now under discussion was the unanimous passing of a resolution opposed to the holding of a national meeting of the association and its affiliated societies during the war period. This action was reported in the November, 1943, issue of the *A.A.A.S. Bulletin*, p. 83.

A week later a similar conference of the secretaries living in the Middle West was held in Chicago. This conference was attended by 22 persons, five more than the one held in New York, and it had four more representatives of the biological fields. This conference also was regarded as highly beneficial by all attending it. In one respect the decisions reached at the Chicago conference differed sharply from those of the New York group. The ten representatives of the biological societies, including the secretaries of both the sections on the zoological sciences and the botanical sciences, and also the secretary of the American Society of Zoologists, at a group meeting after the luncheon, unanimously adopted the following "suggestion," after having been informed of the resolution, mentioned above, that had been passed at the New York conference:

> In view of the importance of maintaining scientific work in America, not only for its contribution to the successful prosecution of the war, but also to prepare for its postwar development and to help insure that the scientific work of this country retain its position in the world field, and believing that national meetings contribute in no small degree to such purposes, we suggest that the A.A.A.S. sponsor a meeting of sections F (zoological sciences) and G (botanical sciences) and their affiliated societies some time in 1944, subject to limitations of travel.

It will be recalled that the Allied countries made important progress toward victory during 1943 and the early months of 1944. The Russians had conducted tremendously effective campaigns against the Germans. The German armies had been thrown out of Africa and Sicily. The Fascists had collapsed in Italy. Extraordinary progress had been made against the Japanese. German cities were being reduced to ruins by British and American air forces, and vast armies were being assembled to invade continental Europe. Victory for the Allied Nations within a year seemed assured.

At a meeting held on February 6, 1944, the Executive Committee of the association considered the advisability of holding a general meeting during the year, as recommended by the biologists at the Chicago conference. So many different organizations cooperate in the great meetings of the association that many months are required for their preparation. Consequently if a general meeting of the association and its affiliated societies were to be held in 1944 it would be necessary to reach a decision at that meeting of the Executive Committee. If a general meeting were not to be held in 1944, one could not be held until late in 1945, presumably a considerable period after the close of the European phase of the war. After carefully surveying the situation and considering the great importance of reestablishing the normal course of science, the Executive Committee on last February 6 unanimously authorized the holding of a general meeting of the association in cooperation with its affiliated societies in 1944 at a time and place to be determined by the office of the permanent secretary.

Immediately after the decision was made to hold a meeting in 1944, conferences of the secretaries of the sections of the association and of the secretaries of the affiliated societies were organized and held to make plans for it, those living in the Middle West attending the Chicago Conference and those living in the East attending the New York Conference. Dr. Carlson, president of the association, attended both of these conferences, and several other members of the Executive Committee were present at each of them. These conferences were so successful that it was decided to hold similar ones yearly in the future for the purpose of formulating cooperative plans for advancing science and human welfare.

In the latter part of this past June a circular letter was received from ODT, asking that all organizations whose meetings or conventions are not definitely and urgently war-connected be canceled for 1944. The opening paragraph of this circular letter is as follows:

> The recent invasion of Western Europe has placed a new emphasis on the urgent need for conservation of all possible travel facilities in this country for the use of military and essential war-connected traffic. Added to the already heavy burden of transporting men and munitions of war, the carriers will soon be faced with the problem of transporting comfortably and quickly, from ocean ports to military hospitals, our wounded Service personnel, who will be evacuated from the theaters of war. This will be done, even if it requires the cancellation of entire regular trains, cars, or individual sleeping car space previously reserved.

The paragraph quoted can not fail to arrest the attention of every scientist, for scientists have given unfailing support to the war efforts of our country. However, scientists are interested in the basic facts on which conclusions are based. As will be shown, the capacities of American railroads for carrying both freight and passenger traffic are strained to the limit. In the first place, the railroads not only had to struggle under the continuous depression from 1930 to 1940, but they were subject to steadily increasing competition from automobiles, trucks and airplanes. The result was that by 1940 the number of railroads in receivership had risen to 103, with only 38 per cent. paying any dividends. In the interval from 1930 the number of locomotives in service had decreased from 60,000 to 44,000, the number of freight cars from 2,300,000 to 1,700,000, and the number of passenger cars from 54,000 to 38,000. Ordinarily new railroad equipment can be obtained to meet increasing demands, but the requirements of our war efforts for steel and manpower made it impossible to replace even all that had to be retired. Even in the low-depression year 1937 the railroads put into service 91,000 new freight cars (105,000 retired), but in the first four months of this year only 10,000 have been put into service in the United States. The difficulties of the railroads have been increased by the shipment of locomotives and freight cars for use near various war fronts, together with great quantities of necessary auxiliary equipment.

In connection with the Cleveland meeting scientists are interested, of course, only in passenger travel, but the burdens on the railroads are due both to freight traffic and passenger travel. To be critical of the railroads for inconveniences in passenger travel would be wholly unjustified because they have served the country with extraordinary efficiency under exceedingly difficult conditions. But to return to passenger traffic, and to only the railroads in the Eastern District, because they will be involved primarily in transporting our wounded from the European war front, referred to in the ODT circular letter quoted above, the average daily number of passengers carried in 1941 was 960,000. In 1942 the average daily number had risen to 1,130,000, and to 1,640,000 in 1943, an increase of 680,000 per day on eastern railroads in two years.

A relevant question is whether this great increase in travel is due to travel of our armed forces or to civilian travel. Precise figures on this point are not available, but it is clear that the recent increases in railroad travel can not be due largely to our armed forces for the simple reason that even if their numbers in the Eastern District alone have increased by 3,000,000 in two years, and if they have traveled by railroad once every ten days, still the average increase in travel per day would be only 300,000, leaving an increase of 380,000 to be accounted for only by civilian travel.

The conclusion appears to be inescapable that the congestion on railroad passenger trains is largely due to great increases in civilian travel, as might be expected when there is much more money in circulation than ever before and when savings accounts are far above any previous level. With money flowing freely the general public is traveling extensively, of necessity largely by train. In comparison with other civilian travel, that of scientists is extremely small. Hence the real question is whether scientists are justified in attending scientific meetings in competition with other civilian travel and at considerable personal discomfort, even though by doing so they add a little to the burdens of overloaded railroads. Certainly by doing so they will not interfere with transportation of wounded men from our battle fields nor in transporting our armed forces over seas. They will, however, go contrary to the requests of the ODT, though the ODT in the paragraph previously quoted, appeared to leave the decision to the conscience of the individual. The difficulties of the railroads, so far as passanger traffic is concerned, are due of course to the simple fact that there is no easy method of controlling the civilian public from traveling to visit friends and for pleasure.

All these questions were considered by the members of the Executive Committee immediately after the June circular letter from ODT, several of whom are devoting their full time to our war efforts and are compelled to travel a great deal in connection with their war work. With one exception they voted to go ahead with the Cleveland meeting in spite of the inconveniences and hardships of travel. In fact, they went further and said that scientists owe it to our civilization to keep the torch of science aloft, whether or not it is concerned directly with the war, in these critical days of the world's history. This is the attitude of men who have asked nothing for themselves during this war period, and who now ask for nothing except the privilege of serving their country in an even broader way. It would be of no avail if the Allied Nations should win the war and not build a much better future. It is for the purpose of protecting this future that the association will meet in Cleveland in September, instead of deferring its meeting to some uncertain time after the close of the war.

It may well be that the consciences of some scientists will not permit of their traveling to Cleveland at the present time. If that is their decision, it is one which all good men will fully respect, and welcome their participation again in scientific meetings when conditions will present no barrier to their attending them. The very spirit of science guarantees such freedom of conscience, and no scientist will question it.

DECIDUOUS FOREST MAN AND THE GRASSLAND FAUNA. II

By Professor V. E. SHELFORD
UNIVERSITY OF ILLINOIS

III. Destruction of Carnivores

In the original state the coyote, badger, kit fox, black-footed ferret, weasels and bull snake, all of which can be allowed to operate on cattle ranges, kept the plant eaters in check. They were aided by the wolf and the rattlesnake which stockmen can not be expected to tolerate, but the smaller carnivores appear to increase following the withdrawal of the larger ones. The work of the carnivore group was of inestimable value to the species of the entire community before man interfered.

(1) *Prejudices.* Due to prejudices and carrying out of eastern and European practices, the enemies of rodents were sought out and killed by cattlemen and farmers and at the same time trapped for their skins. The results of these efforts were, however, much more far reaching in the grassland, due in a large degree to the easy visibility of their dens, trails, etc. This stands in sharp contrast to the difficulty in locating such animals in the forests where visibility is bad and hiding places numerous. Foxes had always been destroyed by agriculturalists in Europe and the eastern states and consequently, anything that looked like a fox, even a small one, was thought dangerous to livestock and poultry. Some of this killing has always been accidental. Poison was often used and in some cases the results were not intended by the settlers. Dr. C. D. Bunker (personal communications) of the University of Kansas Museum, states that the kit fox, which is beneficial to agriculture, was generally destroyed by poison put on buffalo carcasses by cattlemen to kill wolves, during the period of buffalo slaughter.

The badger and ferret were under suspicion, on the basis of European tradition, as raiders of the poultry yard. In his study of the mammals of Texas, Bailey[11] states that the cowboys had a "real grievance against the badgers," because horses step into their holes. But, prairie-dog holes are also dangerous, and badgers help to reduce the number of these pitfalls. The rapid increase of prairie dogs in certain parts of Texas is unquestionably due in great measure to the destruction of badgers.

(2) *Results of Carnivore Destruction.* The rodents of the grassland, particularly ground squirrels, prairie dogs, kangaroo rats and jack rabbits, for some time past, have constituted a problem in grazing areas as competitors of livestock (see Taylor and Loftfield[12]). Their increases on the plains, following settlement, are well described by Merriam[13] in the 1901 Yearbook:

> On many parts of the plains prairie dogs were more abundant in 1900 than formerly and their colonies have overspread extensive areas previously unoccupied. This is due to the aid of the settlers (1) by decreasing the animal's natural enemies, and (2) to a minor extent by increasing the food supply. The settler waged warfare against the coyotes, badgers, hawks, owls, snakes, and other predatory animals which previously held the prairie dogs in check. The prairie dogs had multiplied until they had become a pernicious enemy to agriculture. For example, one South Dakota settler stated that about 1885 his children noticed two or three burrows about a mile from his house, and in 1900 they had spread over and occupied a full quarter section (160 acres), having surrounded his house and taken possession of the land near it.

The damage done by prairie dogs results in the loss of grass eaten and buried under the mounds. Merriam cites many examples of losses. A cattle ranch had its carrying capacity cut from 1,000 cattle to 500 by an increase of prairie dogs which extended to cover 300 square miles. In the same area there was a decrease in population and the abandonment of a post office.

As the stockmen began to feel the losses resulting from their own depletion of the forage grasses, they first redoubled their efforts against carnivores. This involved the destruction of wolves, coyotes and other animals on the plains because of their alleged destruction of livestock and game. As the destruction of the enemies of rodents advanced, the increase in rodents called for their destruction and the use of poison for rodents. This was recommended by the Biological Survey in 1901.

About 1917 the Federal Government took it upon itself to assist in the control of predatory animals and rodents in the western area. The process of providing funds for the destruction of animals became a matter of politics and, as usual, political leaders secured votes in their promises of better conditions through mammal control with poison, which, no doubt, also greatly pleased manufacturing chemists and their salesmen. The U. S. Biological Survey, during this period of increasing control of mammals from 1916

[11] Vernon Bailey, "Biological Survey of Texas." N. A. Fauna, 25: 1–222, 1905.

[12] W. P. Taylor and J. V. G. Loftfield, "Damage to Range Grasses by the Zuni Prairie Dog," *U. S. Dept. Agr. Bull.* 1227, 15 pp., 1924.

[13] C. H. Merriam, "Prairie Dogs of the Great Plains," Yearbook, U. S. Dept. Agr., 1901: 257–270, 1901.

to 1931, probably had ten to twenty destroyers to every scientific investigator.

During the early part of the poison period, apparently there was no thought of any values for the so-called noxious animals or of other methods being practicable.[14]

IV. The Effect of Overgrazing on the Grassland Animals

Recent investigations have brought out some wholly unexpected effects of overgrazing. Several animals despised by livestock growers and accused of causing depletion of grasses have been found to be innocent to considerable degree. Increases of their populations have been found to be the effects of overgrazing rather than the causes of grass depletion.[15]

Under conditions of the close cropping of grasses in eastern pastures, the grasshoppers and other insects get more of the available forage than the cattle pasturing on the area.[16] It is also the general conclusion of the students of grasshopper "outbreaks" on the western plains that they have their origin in over-grazed areas due to the changes brought about by the lessened cover and the growth of such broad-leafed herbs as are commonly called weeds. Overgrazing definitely favors broad-leafed herbs and thus some species of grasshoppers also. Many of these feed on broad-leafed herbs rather than grasses and should be called weed hoppers.

Vorhies and Taylor[17] state that increases of white-throated wood rats in some ranges are an effect rather than a cause of overgrazing. The rat appears to be an "animal weed" in the same way the grasshoppers are. Its principal foods are cactus and mesquite, which increase with overgrazing. Wood rats are caused to increase, and by disseminating cactus, etc., they tend to accentuate the overgrazed condition.

In the southwest, jack rabbits are favored by overgrazing, which provides more shrubs and broad-leafed herbs. Hence again their increase is in part an effect of overgrazing, and they too are comparable to weeds.[18]

V. Modern Ideas

Three ideas have come forward recently as a result of serious researches. Though doubtless they are far from new they are still farther from the field of practical application by agriculturalists, range supervision and game managers. They may be stated as follows:

(1) Biological control, *e.g.*, certain of the carnivores may be used to control rodent populations.

(2) Burrowing animals are beneficial to the soil in the grassland areas.

(3) Predators in the long run are beneficial to game species. They may be discussed in the order above.

(1) *Biological Control.* The discussion by Merriam indicates that the reverse of biological control is a fact: "The prairie dog and ground squirrels have several mortal enemies which, when not interfered with by man, usually serve to hold their numbers in check." The most important of these as listed by Merriam were the coyote, kit fox, badger, black-footed ferret, bull snake and rattlesnake.

The writer, after extended inquiries among plains biologists and an examination of the literature on the subject and an inspection of large areas of the great plains, came to the conclusion that the predators necessary for a study of the possibilities of biological control of mammals did exist on the plains at one time. A goodly number of species not incompatible with agriculture were once available in abundance and still exist in reduced numbers. The conclusion was that there had never been well-planned attempts to try out biological control of rodents on grazing lands. Several of the predators have been absent. Cases which the Biological Survey has cited as examples of the failure of predator control of rodents have been inadequate to prove anything of value as they were more or less incidental to the regular control operations. Accordingly biological control of mammalian populations has not been tried. It should, however, be the regular practice on grazing lands in arid areas because of the benefits of the burrowing animals to soils.

(2) *Benefits to Soil.* Vorhies[17] has written regarding the benefits of rodents to the soil. He states that in areas in which burrowing rodents are important in the loosening up and aeration of the soil—as in the earthwormless, arid Southwest—the little animals deserve to have the possible benefits they confer on the soil carefully balanced against the possible ill effects on erosion or as competitors of livestock. "It may be fairly questioned whether rodents, by and large, are important in causing erosion directly."[18]

(3) *Benefits by Predators.* Murie[19] concludes his study of the coyote in Yellowstone Park with the following paragraph: "In the present study every effort

[14] S. F. Olson, *Scientific Monthly*, 46: 323–336, 1938.

[15] C. T. Vorhies and W. P. Taylor, "The Life History of the Kangaroo Rat," *Professional Paper; U. S. Dept. of Agr. Bull.*, 1091: 1–40, 1922.

[16] G. N. Wolcott, "Animal Census of Two Pastures and a Meadow in Northern New York," *Ecol. Mon.*, 7: 1–90, 1937.

[17] C. T. Vorhies and W. P. Taylor, "Life, Biology and Ecology of the Jack Rabbits," *Univ. of Ariz. Agr. Expt. Sta. Tech. Bull.*, 49: 472–587, 1933.

[18] C. T. Vorhies, (a) "Wildlife Aspects of Range Rehabilitation." *Hoofs and Horns*, N. 5, No. 8: 6–7; N. 5, No. 9: 10–11, 1936. (b) "Control Projects Provide Easy but Dubious Way to Spend Money." *Nat. Magazine*, 28: 363–365, 1936.

[19] A. Murie, "Ecology of the Coyote in the Yellowstone Fauna of the National Parks of the United States." *Bull.*, 4: 1–206, 1940.

has been made to study the coyote in the interactions with all elements of the fauna and its relation to human interests. In consideration of these findings and the absence of facts to show that the coyote is an undesirable element of the wildlife in Yellowstone, it is concluded that artificial control is not advisable under present conditions." The paper in general refutes most of the charges against this animal. Again Olson has defended the presence of the large wolf in the Superior National Forest on the ground that it is really a benefit to the game. All in all the idea is growing that decisions as to the treatment of species suspected or believed to be detrimental to man's interests should await precise data based on special researches.

VI. Conditions Necessary for Needed Scientific Research

To test the value of the kit fox in the control of rodents and the several other modern ideas that have been advanced calls for a large tract of land (approximately 1,000,000 acres). It can be poor land suitable for grazing only. The fauna would have to be largely restored, and the species reduced in numbers allowed to rebuild to original status by protection, in order to bring back an approach to the original balance. The plants would also have to be allowed to recover from overgrazing or plowing. The processes involved in the recovery of the biotic community are much in need of investigation, and thus the time devoted to restoration is as profitable as any other from the research standpoint. The great plains have come to constitute one of the great national economic problems of the United States. The variable rainfall, unscientific exploitation, chiefly with the plow, and the loss of the soil, the reduction of animals beneficial to soils, call for serious longtime research work which can be combined with a National Monument which will preserve the original fauna in a natural state for posterity while retaining historic conditions of the covered wagon days.

At a recent Wildlife Conference[20] in Chicago, the Secretary of Agriculture stated that the United States is at the turning point. We either start saving and restoring our soil and biological resources or go down to economic destruction. (He no doubt had in mind the fate of certain Mediterranean countries.) In the same session a prominent official of the Department of the Interior stated that a sound national policy requires that more land come under public ownership in the national interest, even though it conflicts with some local interests. Public ownership of grassland is necessary for a long time continuous study of grassland problems. Work in this relatively untouched field is an essential part of any national conservation program.

OBITUARY

ROY E. DICKERSON

February ended the careers of a number of prominent geologists. Not the least was Roy E. Dickerson, who died of a coronary thrombosis at the American Institute of Mining and Metallurgical Engineers annual meeting in February. Funeral services were conducted in Arlington, Virginia, and the ashes will be interred in California.

The son of Merritt Michael and Martha Gilmore Dickerson, he was born at Monticello, Ill., on August 8, 1877. His entire university career was at the University of California, where he received the degree of B.S. in 1900, of M.S. in 1910 and a Ph.D. in 1914. His education, however, never ceased and he was as ardent a student on the morning of February 24 as he had been in university days.

Mr. Dickerson taught in California high schools and completed his graduate work while at Polytechnic in San Francisco. In addition, beginning as part-time curator in 1907 he became curator of paleontology at the California Academy of Science. During the summer, he taught at the University of California and acted as paleontologist for the Standard Oil Company of California.

In 1918, he joined the Standard as a full-time employee and became geological superintendent in the Orient. He served the Atlantic Refining Company in Middle and South America from 1926 to 1935, when he was promoted to chief geologist (foreign). In 1942, he became chief of the Technical Section of the Petroleum Division of the Foreign Economic Administration.

During nearly four decades of travel, he was accompanied by his wife, the former Delle Howard, of Cloverdale, Calif., whom he married on July 14, 1904.

Mr. Dickerson's most important publications were in paleontology, physiography and stratigraphy. While a graduate student, he completed a series on the Tertiary of the Pacific Coast. In later years, he devoted attention to the physiographic development of the East Indian and Philippine Islands, particularly as evidenced by the distribution of life. In spite of executive responsibilities of the last decade, he continued study and writing, leaving several unpublished manuscripts.

[20] Widely quoted by the press and to be published in the Transactions of the Ninth North American Wild Life Conference.

As a scientist, he had one of the best geological minds in Washington, and as a man, he was a friend, in all that the name implies. No one was more persistent and stubborn in the search for truth, or more kindly and tolerant in his dealings with humanity. After a trying day in the field, he was never too tired to help a subordinate, to do a favor for an acquaintance, to play a set of tennis or a hand at bridge. Both foreigners and natives, in South America, held him in the highest respect and confidence. He was a hard worker, a brilliant conversationalist, a jolly companion and, above all else, a true and loyal friend. We shall miss him sorely.

H. W. STRALEY, III

PRINCETON, W. VA.

RECENT DEATHS

DR. CLYDE HADLEY MYERS, professor emeritus of plant breeding at Cornell University, died on August 5. He was sixty-one years old.

DR. JOHN C. HESSLER, since 1934 president of James Millikin University, died on July 29 at the age of seventy-four years. Dr. Hessler was professor of chemistry at Millikin University from 1907 to 1920 and at Knox College, Galesburg, from 1921 to 1934.

DR. HARRISON GARMAN died on August 7. He was head of the department of entomology and botany of the Kentucky Agricultural Experiment Station from July, 1889, to 1929, and served as State Entomologist of Kentucky from 1897 to 1929, when he reached the retirement age.

DR. LOUIS A. JULIANELLE, bacteriologist, chairman of the Division of Infectious Diseases of the Public Health Research Institute of the City of New York, died on August 12. He was forty-nine years old.

DR. J. W. HAZZARD, head of the department of zoology at Southern University, Louisiana, died on August 15 at the age of forty years.

A CORRESPONDENT writes: "Dr. Horace Russell, Jr., died on August 5, at the age of twenty-seven years, as a result of injuries received in a fall while horseback riding. He was for five years research fellow and instructor in inorganic chemistry at the California Institute of Technology. He received his bachelor's degree in 1938 at Duke University and the degree of doctor of philosophy at the California Institute of Technology in 1941. He was the author of several scientific articles and was co-author of a book on advanced inorganic chemistry. During the period of the war Dr. Russell was engaged in war work for the Office of Scientific Research and Development. He had been away from Pasadena for several months before his death in connection with this work."

DR. LEO FRANK GOODWIN, professor of industrial chemistry and chemical engineering and head of the department at Queen's University, Canada, died on August 15 at the age of sixty-two years.

SIR HENRY GEORGE LYONS, F.R.S., the meteorologist and geographer, died on August 11 at the age of eighty years.

SCIENTIFIC EVENTS

A NATIONAL CHEMICAL LABORATORY FOR INDIA

A PLAN for the establishment after the war of a National Chemical Laboratory for India to specialize in industrial research and to develop new processes has been drawn up by the Council of Scientific and Industrial Research at Delhi.

It is proposed to follow more or less the lines of the chemical research laboratories of the National Physical Laboratory. Emphasis will be laid on industrial research and the development of new processes up to the pilot plant stage, so that the chemical industry and other industries requiring the aid of chemical research in general will benefit from the investigations carried out. It is pointed out that

in India such facilities for research work up to the pilot plant stage are rarely available and such scientific research as has been carried out so far has not been so convincing to industrialists and the would-be manufacturers as it might have been if the success of a process had been demonstrated on a large scale.

This aspect of the question will distinguish the National Chemical Laboratory from the rest of the laboratories either in the universities or in any technical institution run privately, or under semi-government control. It will maintain the closest cooperation with existing institutions, particularly as the National Laboratory will be able to initiate those ambitious investigations which are not carried out in university laboratories either for want of funds or for the reason that the problems have a predominantly industrial bias.

It is proposed that the laboratory should provide accommodation and facilities for the following main branches of chemistry: inorganic chemistry, including analytical investigations; organic chemistry, including drugs and chemo-therapy; physical chemistry, including high-pressure technique and electro-chemistry; biochemistry, including biological products and chemical engineering. The workshops and pilot plant equipment suggested for the laboratory should enable it to undertake any type of industrial research. Public opinion on the tentative scheme has been invited.

REPORT ON POST-WAR EDUCATION OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

A REPORT on post-war university education has been made by the British Association for the Advancement of Science. It was prepared by a committee under the chairmanship of Dr. Maxwell Garnett and some sections have already been published.

A summary of the conclusions of the committee is given in *The Times,* London. It reads:

University entrance scholarships in England and Wales should, in the committee's view, depend more than at present upon a candidate's character as well as upon his knowledge and intellectual qualities. The assessment of deep scholarship should always be supplemented by the assessment of character; and the latter should carry equal weight in the assessment of university-worthiness in the case of a majority of assisted students. Other recommendations are made to overcome the excessive concentration of the upper forms of secondary schools upon the deep study of one or more specialized subjects, to the neglect of the wider study of the world as a whole.

The committee notes the tendency of university studies to split up into a growing number of separate specialisms, lacking any integrating principle and increasingly divorced from the life of the community. Two distinct replanning proposals are made: (1) A type of general degree course, including both natural science and humanities; and (2) including, in the existing specialized schools in natural and applied sciences, courses in the elements of sociology and citizenship. Every undergraduate, it is urged, should acquire some appreciation of the achievements of science and their impact upon daily life.

The relation between universities and government administration is seen to be close and the growth of overspecialization as dangerous to intending civil servants as to any other type of university student. Some form of education designed to facilitate the process of international cooperation is recommended, and courses are also proposed for civil servants after a period of service. The committee is unanimous on the need for university schools of education to play an essential part in the education of all qualified teachers. Educational research and the teaching both of undergraduates and of experienced members of the teaching profession who return for courses of advanced study should be the concern of every university.

The committee holds that it is to state and local assistance that the universities must look in the immediate future for their major development. Large additional expenditure will be needed in many directions, but raising the salaries of university staffs of all grades, at present hopelessly inadequate in competition with the world outside, should be given high priority. At least £1,500 a year at 1938 prices should be paid to all whole-time professors.

Agreeing with the Parliamentary and Scientific Committee that a Universities' Advisory Council should "be established by the universities themselves to consider the whole range of university policy and act as a coordinating body," the committee adds that the council should be entirely free from government control. This council would make representations to the University Grants Committee. To promote university cooperation on a world scale the committee suggests a World Council of Universities.

Surveying the position of universities in war areas, the committee recommends that the United Nations should require the enemy powers to make full restoration of university property stolen or destroyed.

POST-WAR CONSTRUCTION PLANS OF THE UNIVERSITY OF CALIFORNIA

A BUILDING program, which involves an expenditure of more than $27,500,000, to be undertaken after the war, has been announced by the University of California. The Legislature had already appropriated the sum of $4,331,000, which will be available as soon as conditions permit construction. At the recent special session the sum of $24,525,000 additional was set aside for the building program from postwar construction funds, from which appropriations will be made as the university is able to use the money. Another appropriation of $1,100,000 was made by the Legislature for plans and specifications of the proposed buildings, so that there may be no delay when construction becomes possible. Work on preliminaries already has started, the architects working with a committee on each campus. Details of the sums appropriated are given below.

$7,375,000 will be spent for buildings, as follows: Hesse Hall addition, engineering, $100,000; library, $1,250,000; engineering building, $1,000,000; School of Public Health, $1,500,000; chemistry laboratory, $600,000; jurisprudence building, $675,000; forestry building, $600,000; forest products laboratory, $500,000; anthropology, $500,000; home economics, $500,000; insectary, $50,000; utilities expansion, $100,000.

At Los Angeles, buildings to cost $8,500,000 are planned as follows: student health center, $450,000; student hospital, $600,000; library, $750,000; engineering, $1,250,000; social sciences, $750,000; life sciences, $1,000,000; College of Business Administration and Economics, $750,000; geological sciences and petroleum engineering, $850,000; men's gymnasium addition, $300,000; women's gymnasium addition, $300,000; home economics, $500,000; administration building addition, $250,000; outdoor theater completion and seats, $235,000; education or art, $500,000; utilities expansion, $100,000.

At San Francisco, $6,025,000 will be spent for teaching hospital, $4,000,000; medical science, $1,000,000; nurses' home, $500,000; internes' quarters, $200,000; dental clinic, $100,000; generator plant, $135,000; laundry, $90,000.

At Davis, the expenditures will be: veterinary science, $1,000,000; plant sciences, $500,000; soils and irrigation, $300,000; poultry husbandry, $250,000; student health center, $150,000; home economics, $500,000; Putah Creek bridge, $6,000; utilities expansion, $50,000.

At La Jolla, $225,000 will be spent: library, museum and aquarium, $125,000; pier repairs and rehabilitation, $50,000; sea wall, $25,000; utilities, $25,000.

At Mt. Hamilton, $900,000 will be spent for a new reflecting telescope, and $75,000 for fire protection and rehabilitation of buildings.

At Riverside $420,000 will be spent on a library building, with auditorium, $300,000; on an insectary, $60,000; and on heating plant, $60,000.

At Santa Barbara College, $1,500,000 will be spent on new buildings.

THE MEDICAL HISTORY OF THE WAR

AT a meeting of representatives of the professional and administrative services of the Office of the Surgeon General, held in Washington on July 26, plans were discussed and progress reports were made on the medical history of the war, work on which has been in progress since August, 1941. It is being carried out under the direction of Colonel Albert G. Love, of the Army Medical Department, who was a member of the editorial staff that published the history of the Medical Department of the United States Army in World War I.

Editors have been selected for the volumes on the medical specialties and the administrative phases of the medical service. In addition to the research and editorial work to be done in the Office of the Surgeon General, historical investigations will be carried forward by officers assigned to the headquarters of overseas theaters. They will secure first-hand reports of over-all medical services, particularly those rendered under combat conditions, including evacuation of the wounded and the flow of supplies. Officers overseas who have had extensive experience with medical and surgical problems peculiar to this war are being asked to record their observations.

When first organized, the historical activities of the Medical Department relative to professional subjects were part of a joint plan to be undertaken in cooperation with the Subcommittee on Historical Records of the Division of Medical Sciences of the National Research Council. The administrative and organizational volumes were to be prepared by the Medical Department. This plan, however, was modified recently in accordance with the wishes of Surgeon General Norman T. Kirk, who believes that the Medical Department should assume full responsibility for its entire history.

SCIENTIFIC NOTES AND NEWS

DR. HARLOW SHAPLEY, Paine professor of astronomy at Harvard University and director of the observatory, and Dr. George David Birkhoff, Perkins professor of mathematics and dean of the Faculty of Arts and Sciences, have been elected to honorary membership in the Mathematical Society of Mexico.

THE University of Oregon conferred at its commencement exercises the doctorate of science on Dr. Ralph W. Chaney, professor of paleontology at the University of California at Berkeley, "in recognition of his penetrating researches in paleobotany in general and of the Oregon area in particular; his unique understanding of the historical geology of Western America in relation to that of Asiatic countries; and his deep appreciation of the kinship of science in its broadest aspects and its contribution to the understanding of human values."

ARTHUR PHILLIPS, professor of metallurgy at Yale University, has returned from a three months stay in Brazil. During his visit the University of São Paulo, Brazil, conferred on him the honorary degree of *doctor honoris causa,* in recognition of his contributions to metallurgy and of a series of lectures given before various Brazilian groups. He was one of three Americans who visited Brazil under the sponsorship of the Office of the Coordinator of Inter-American Affairs. The Associaco Brasileira de Metals presented him with a gold medal and elected him a director of the society. At the conclusion of the lectures, he was conducted on a two-week tour of the mining districts of Brazil, in order to learn at first hand the problems facing the metal producers there.

THE Cameron Prize in Practical Therapeutics of the University of Edinburgh has been awarded to Dr. Otto Loewi, research professor of pharmacology at New York University, in recognition of "his fundamental work on the chemical transmission of the nervous impulse."

PROFESSOR W. STORRS COLE, of the department of geology of the Ohio State University, has been elected a member-at-large of the National Research Council. He has been assigned to the division of geology and geography for a three-year term ending on June 30, 1947.

DR. E. F. KELLY has resigned as secretary of the American Pharmaceutical Association.

DR. GILBERT SHAW SCOTT, the first secretary of the British Institute of Metals, is retiring after having served for thirty-six years.

DR. G. E. POTTER, of the Agricultural and Mechanical College of Texas, has leave of absence to enable him to become visiting professor of biology at the

College of Agriculture and Mechanic Arts of the University of Puerto Rico at Mayaguez.

PROFESSOR CHARLES R. KEYES, professor at Cornell College, who retired two years ago, has been appointed visiting research professor in anthropology at the State University of Iowa. For a number of years he has been engaged in the study and excavation of Indian habitation sites and mounds in Iowa, a project which was subsidized in part through the university. He has assembled and classified a valuable collection of materials, which he has presented to the University of Iowa and to the Iowa State Historical Society. His assignment under the present appointment is to write a monograph describing and interpreting the collection.

DR. FREDERIC A. WOLL, professor of hygiene at the College of the City of New York and director of the department, having reached the age of seventy years, retired this month.

DR. ROBERT C. DISQUE, dean of the School of Engineering of the Drexel Institute of Technology, Philadelphia, has been elected president of the institute to succeed Dr. George Rea.

AN Associated Press dispatch reports that Alfonso Caso, the archeologist, has become president of the National University of Mexico to succeed Rudolfo Brito Foucher, whose resignation is said to have been forced owing to the opposition of the students to his administration.

DR. FRED F. MCKENZIE, head of the department of animal husbandry of the Utah State Agricultural College, has been appointed professor of animal husbandry and animal husbandman at the Oregon State College.

DR. LESLIE A. STAUBER, associate in pharmacology at the Squibb Institute for Medical Research, has been appointed assistant professor of zoology at Rutgers University.

DR. ANGUS E. TAYLOR, assistant professor of mathematics at the University of California at Los Angeles, has joined the Operations Analysis Section of the Army Air Forces, where he expects to carry on mathematical research. Others who have undertaken civilian work with the A.A.F. are Dr. Joseph Kaplan, professor of physics; Dr. Wm. Whyburn, professor of mathematics, and Dr. Paul G. Hoel, assistant professor of mathematics.

DR. HARDEE CHAMBLISS, professor of chemistry retired, and some time dean of the School of Engineering of the Catholic University of America, has joined the staff of the Geophysical Instrument Company, Arlington, Va., as consulting chemist. He will give a general introductory course in geochemistry at the Graduate School of the U. S. Department of Agriculture, in which geochemical prospecting for oil and minerals will be among the topics discussed.

DR. GEORGE A. ZENTMYER, of the Connecticut Agricultural Experiment Station at New Haven, has been appointed assistant plant pathologist of the Citrus Experiment Station of the University of California at Riverside, to succeed the late Dr. William T. Horne.

LIEUTENANT COLONEL MORTON A. SEIDENFELD, formerly director of rehabilitation of the Tuberculosis Institute of Chicago and Cook County, has become chief clinical psychologist of the Advisory Board on Clinical Psychology of the Office of the Adjutant General, of which Dr. Walter V. Bingham is chief psychologist.

AT Cornell University, Dr. E. M. Hildebrand, assistant professor of plant pathology, has resigned to become plant pathologist of the Research Division, Food Machinery Corporation at Dunedin, Fla., and Dr. V. L. Frampton, also assistant professor of plant pathology, has resigned to become research chemist in the new Cotton Institute at Dallas, Texas.

DR. WENDELL M. STANLEY, member of the Rockefeller Institute for Medical Research, and George B. Wells, president of the American Optical Company, have become members of the Board of Trustees of the Worcester Foundation for Experimental Biology.

DR. RAYMOND B. COWLES, associate professor of zoology at the University of California at Los Angeles, has left for Florida to take part in a study on the relation of temperature environment to animals, especially reptiles and amphibians, under the auspices of the American Museum of Natural History and the University of California. He will spend several weeks at the Archbold Biological Station at Sebring conducting an investigation of Floridan species.

DR. C. H. BEHRE, JR., professor of geology at Columbia University, has been granted leave during the summer to continue his work in charge of zinc and lead exploration in the southern Appalachians and the upper Mississippi Valley district for the United States Geological Survey.

E. S. RIGGS, honorary curator in vertebrate paleontology of the Museum of Natural History of the University of Kansas, has returned from western Kansas, reporting successful collecting from a pocket of Pliocene mammals, discovered last year. Dr. Claude W. Hibbard, curator, will remain in the field until September.

AN expedition of the Cranbrook Institute of Science and the University of Michigan returned in mid-August from the region of the new Mexican volcano, El Parícutin. The party made preliminary investigations of the effect of ash deposition on the survival of

plants and vertebrate animals at varying distances from the volcano, and obtained evidence of probable centers of repopulation of the denuded area. So far as known, this is the first attempt to study the subject of life destruction and recovery from volcanic action that has been initiated while the forces of destruction were still active. Members of the party were Robert T. Hatt, Marcelle R. Hatt and A. N. Goddard, of the Cranbrook Institute, and William H. Burt, of the University of Michigan. They collected mammals, plants and geological material around the volcano at Angahuan and at Uruapan, 1, 11 and 35 kilometers, respectively, from the cone.

A TECHNICAL meeting of the American Institute of Electrical Engineers will be held at Los Angeles from August 29 to September 1. The program will be devoted to electrical applications to military aircraft.

THE International Business Machines Corporation presented to Harvard University, on August 6, an automatic sequence controlled calculator. It was accepted with appropriate ceremonies by President James B. Conant as a gift from the corporation. Commander Howard Aiken, now on leave as associate professor of applied mathematics at the university, originated the basic theory which led the corporation to assign its engineers to invent a machine which would carry out the calculation desired by Commander Aiken over a period of six years. Clair D. Lake, inventor of printing accounting machine mechanism, was placed in charge of the invention of the machine at the laboratory of the corporation at Endicott, N. Y., with Commander Aiken and Frank E. Hamilton, engineer. This group was responsible for the development of the invention. The calculator will be used by the Navy for the duration of the war.

BEGINNING with January, 1945, it is planned to bring out a *Journal of Clinical Psychology*. It will be a professional journal limited to the publication of original research and authoritative theoretical articles in the field of clinical psychology. The journal will appear quarterly and will contain about three hundred and twenty pages annually. Editorial and business offices will be at the Medical College Building of the University of Vermont, Burlington. One of the purposes of the *Journal* will be to work toward a more formal organization of professional resources in clinical psychology and to improve inter-professional relations with other sciences, including psychiatry.

THE *Journal* of the American Medical Association reports that the selection of a professor of nutrition at the Medical School at Tufts College is being considered. Last year a fund was established to commemorate the seventieth birthday of Miss Frances Stern, chief of the food clinic of the Boston Dispensary, the fund to be used by Miss Stern to extend the research and educational activities of the clinic. Recently a Frances Stern Committee on Nutrition was appointed, and one of its first actions was to approve the selection of a full professor of nutrition and to recommend a survey by members of the faculty who have included nutrition in their courses. The Charles Hood Dairy Foundation, a local group, has voted to contribute annually for three years half the amount that the nutrition committee estimates would be needed to begin the project.

THE third Postgraduate Course in Industrial Medicine will be given from October 16 to November 3 under the auspices of the Department of Preventive Medicine and Community Health of the Long Island College of Medicine. It will be conducted by more than fifty leading physicians in industrial practice, authorities in allied fields and members of the faculty of the college. Two similar courses were given in 1942 and 1943. The course this year will place particular emphasis on post-war conditions and problems associated with the return of workers from military service. Although designed for graduate physicians, it will be open to industrial executives, personnel workers, industrial nurses, hygienists, engineers and to others interested in industrial health. It will include afternoon and evening lectures, and seminars, supplemented by morning clinics and demonstrations arranged in cooperating hospitals and industrial medical departments.

CHEMICALS wanted by the National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, Illinois, include: Ammonium chlorate, ammonium bromate, aluminum carbide, 3,4-benzphenanthrene (.2g), cytosine, dibenzyl ketone, alpha-(2,5-dimethyl phenoxy) propionic acid, 3,4-dimethyl phenoxy acetic acid, folic acid, guvacine or guvacoline (1,2,5,6-tetrahydronicotinic acid and methyl ester), 25g, beta (4-hydroxy phenyl) lactic acid, mono and di-iron phosphides, 1-((N-methylol stearic acid amido) methyl) pyridinium chloride, methyl-n-amyl ether, 2-methyl-3-(beta hydroxy ethyl) pyridine, pyrazine, sodium salt of ethyl formyl acetate, sulfamide, triphenyl arsine and triphenyl boron.

IT is stated in the *Journal* of the American Medical Association that the organization of a National Vitamin Foundation was approved at a meeting on May 23 of fifty representatives of all sections of the vitamin industry in New York. Its objectives would be to award grants for research in the vitamins or related fields, the dissemination of information to the vitamin trade, medical profession and public with respect to the quality, purpose and uses of vitamins, adoption of terminology and standards of publicity practices in connection with the sale of vitamins, and to confer

and consult with medical societies, medical schools, health organizations, public health agencies and governmental agencies with respect to vitamins and the vitamin industry. The foundation will be administered by a board of trustees. Details of the organization are to be formulated by a committee of which Basil O'Connor, New York, president of the National Foundation for Infantile Paralysis, has been named chairman.

Industrial Standardization reports that the work of the British Standards Institution has been more than doubled since the beginning of the war as the result of requests from the government for standards for all kinds of war commodities. The institution is conducted by industry, but has a financial grant from the government. About 1,500 standards have been issued to date, and an active postwar program, particularly in the field of building materials, is being planned.

DISCUSSION

UNIPARENTALISM IN THE HYMENOPTERA AND ITS RELATION TO POLYPLOIDY

DURING the period from 1850 to 1853, Foerster[1] noted that the eulophid *Astichus arithmeticus* reproduced generation after generation in the absence of males. This was probably the earliest observation of the uniparental reproduction of females which now is known to occur commonly in the more primitive and biologically plastic groups of Hymenoptera. According to Clausen,[2] the uniparental reproduction of females is not yet known to occur in the Serphoidea, which is perhaps the most consistent of the superfamilies of the Hymenoptera both in host preferences and in relationships.

The capacity to produce males and females without fertilization is characteristic of the Hymenoptera; the normal hymenopterous male having only one parent, the normal female having either one or two parents.

In most, if not all, species each of the sexes produced uniparentally is morphologically capable of mating. The sex attraction, however, may be so weak that mating never occurs. This is known to be the case in certain species of Chalcidoidea and Cynipoidea.

In the majority of known species of Hymenoptera the progeny of the unmated female consist almost entirely of males. In such species the females are biparental provided the conditions of reproduction are those usually prevailing.

In many species, however, both sexes are usually, if not always, uniparental. In such species it is possible that mating may be necessary for providing a stimulus to oviposition.

Certain species consist of geographical races, reproduction being biparental in one and uniparental in the other. Many genera are made up of uniparental and biparental species.

Mackensen[3] observed 21 virgin queen honey-bees which produced bisexual broods. The number of uniparental females from any queen, however, was estimated not to exceed one per cent. of her progeny. The unmated workers of certain species of bees and ants commonly produce female offspring.[4]

The female of many hymenopterous species, therefore, is capable of producing two kinds of eggs; one kind yielding only uniparental females, the other either uniparental males, or, if fertilized, biparental females. Studies by Speicher and Speicher[5] on *Microbracon hebetor* indicate the probable origin of the two kinds of eggs. The occasional uniparental female appearing in this species originated from patches of tetraploid tissue in an ovary, which otherwise was diploid. The unfertilized eggs from such an ovary subsequent to the reduction process would be either haploid (male) or diploid (female).

It is not impossible that changes in the tetraploid and diploid composition of the ovarian tissues of the hymenopterous female result from changes in the environment. It has been observed in a number of species in which both sexes are uniparental that certain changes in the environment produce a marked change in the sex ratio. For example, when peach twigs bearing San Jose scale parasitized by *Prospaltella perniciosi* are brought into the laboratory, males and females of *P. perniciosi* emerge and mate.[6] The first generation reared under laboratory conditions in San Jose scale growing on cow-melons (*Citrullus*) also consists of both sexes. All the subsequent generations on cow-melons, however, consist only of females.

It is evident that the ovaries of females developing in San Jose scale growing on cow-melons are entirely thelyotokous, whereas in females developing in San Jose scale growing on peach twigs the ovaries either are entirely arrhenotokous (the haploid egg being fer-

[1] Arnold Foerster, "Hymenopterologische Studien," Heft 2—"Chalcidiae und Proctotrupii." Aachen, Ernst ter Meer. 152 pp. 1856.

[2] C. P. Clausen, "Entomophagous Insects." 688 pp. New York: McGraw-Hill Book Co., Inc. 1940.

[3] Otto Mackensen, *Jour. Econ. Ent.*, 36: 465–67, 1943.

[4] William Morton Wheeler, "The Social Insects." 378 pp. New York: Harcourt, Brace and Company. 1928.

[5] Kathryn G. Speicher and B. R. Speicher, *Biol. Bul.*, 74: 247–52, 1938.

[6] Stanley E. Flanders, *Jour. Econ. Ent.*, 37: 105, 1944.

tilized to produce females) or they are partially arrhenotokous and partially thelyotokous. Since it is unlikely that the change in host plants would cause the chromosome number to change in all the cells of the germarium, it is logical to assume that irrespective of the host plants the females are uniparental and that the production of males when the peach is the host plant is the result of the occurrence of patches of diploid tissue in ovaries that otherwise are tetraploid.

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DIFFERENTIATION OF THE LATERAL MOTOR COLUMN IN THE AVIAN SPINAL CORD

IT has been shown that the periphery is necessary for the differentiation of the lateral motor column in the embryonic chick;[1,2] also, that this process completes itself to a large extent after the brachial and lumbosacral spinal cords have been isolated from the rest of the nervous system.[1,3] Because of the importance of the peripheral musculature, it was thought that it might be possible to induce a lateral motor column in non-limb segments of the spinal cord from a 2½ day chick embryo. These non-limb segments were removed and transplanted so they would be under the influence of the developing hind limb primordium. In no case was it possible to induce a lateral column.[3]

Brachial spinal cord segments will differentiate a lateral column which will be within 30 to 60 per cent. of the normal number of cells when grafted so as to develop in the presence of the growing hind limb.[3] This indicates that the peripheral requirements for the brachial cord are at this time highly non-specific as to level. Because of the non-specificity of the periphery as to region, it was thought that the peripheral requirements might be non-specific as to genus and species. To test this possibility the lumbosacral spinal cord of the guinea hen (*Numida meleagris*) embryo of 2½ days was removed and transplanted so that it would be under the influence of the developing hind limb of the chick (*Gallus domesticus*). Ten grafts were completed; three were successful. After a total of 9 days incubation the grafted guinea hen spinal cord had given off peripheral nerves which had fused with the lumbosacral plexus, and the side which was next to the limb had a well-developed lateral motor column. The cell count of this column for the three cases studied was within 20 to 50 per cent. of that for the control.

[1] V. Hamburger, *Jour. Exp. Zool.*, 68: 449, 1934.
[2] E. D. Bueker, *Jour. Exp. Zool.*, 93: 99, 1944.
[3] E. D. Bueker, *Anat. Rec.*, 88: 424, 1944.

The above evidence indicates that the limb periphery of another genus is an adequate environment for making possible the partial development of the lateral motor column, and that the peripheral requirements are not specific as to location, since the wing level will differentiate a column when grafted in the leg region. To get the maximum differentiation, however, the volume, growth rate and developmental pattern of the musculature must be that for which the particular segments of the spinal cord are adapted and only the normal periphery can meet these requirements.

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SNOW MELTING AND EVAPORATION

MELTING and evaporation of snow during the winter and spring seasons on the high mountains and plateaus of the Intermountain region are processes of considerable interest to water users in the adjacent arid valleys because they have a direct bearing on the timeliness, rate and amount of streamflow that becomes available during the remainder of the year for irrigation, power and other purposes. Records show that snow accumulates on the watershed lands during the period November 1 to April 1 to depths of from 4 to 10 feet, and that the snow mantle just prior to active melting in the spring may contain from 10 to 50 inches of water. Relatively little is known, however, about the rate at which the snow melts or the amount of water that is lost from the snow mantle by evaporation. To augment the meager knowledge of these phenomena, preliminary studies of snow melting and evaporation were conducted at elevations from 8,700 to 10,000 feet on a portion of the Wasatch Plateau in central Utah during the snow melting season of 1942, some results of which are herein presented.

The snow mantle on a study area at 10,000 feet elevation was 60 inches deep and contained 23 inches of water when measurements of melting began on April 29. All the snow originally on the area, together with an additional 2 inches which fell during the period of measurement, was gone by June 1. During this 33-day period, melting took place only in the daytime, usually from about 2 hours after sun-up to within one-half hour of sun-down. Melting rates varied from 0 to 1.97 inches of water per day by reason of differences in temperature, insolation and air movement.

Snow temperature throughout the daytime melting periods remained at about 32° F., although air temperatures up to 67° F. were recorded at a distance of 4.5 feet above the snow surface. At night a crust often formed on the snow surface which extended to depths of from 1 to 4 inches. Temperatures of 32° F.

were recorded consistently at the contact between uncrusted and crusted snow, whereas they dropped to as low as 14° F. at the surface of the snow crust. Air temperatures at 4.5 feet above the snow mantle rarely dropped below freezing and usually were about 5 to 10 degrees higher than those of the snow surface during the crusting period.

Daily snow-melt was reduced artificially at some of the sampling stations by shading and by minimizing air movement. On May 8, for example, snow-melt in bright sunshine with free air movement totaled 1.3 inches. Total melt in the same day was 0.89 inch on a shaded site with free air movement and 0.47 inch on a shaded site with restricted air movement.

Discoloration of the snow surface increased snow melting on other sites. The daily melt of clean white snow giving a Weston photometer reading of 220 averaged 1.2 inches as compared to 1.3 inches for normal snow giving a Weston reading of 200. Snow surfaces which were darkened by applications of dust and soot so as to give Weston readings of 180 and 150, respectively, melted at rates of 2.0 and 2.4 inches per day.

Rates of snow melting during the day varied from 0.014 to 0.205 inch per hour. Inasmuch as no surface run-off occurred on the site throughout the study period, it is evident that melting was sufficiently slow for all the water to enter the soil at or near the spot where it was released from the snow mantle.

Evaporation from snow during 6 days of measurement between April 28 and May 21 at 8,700 feet elevation varied from 0.005 to 0.07 inch of water per day. The average evaporation for these 6 days was 0.04 inch or the equivalent of about 1.20 inch per month. Greatest evaporation occurred on days when the vapor pressure of the atmosphere at the snow surface was materially greater than at 2.5 and 12.0 feet above the surface. Least evaporation occurred when vapor pressure of the atmosphere approached that at the snow surface. Vapor pressure of the atmosphere exceeded that at the snow surface for a short time on one of the days of record and probably caused some condensation of moisture, although the amount was not measured.

Evaporation during two days in early May averaged 0.54 inch per day on a site having full insolation and free air movement. During the same period, average daily evaporation was 0.52 inch on a shaded site with free air movement and 0.23 inch in the shade with no air movement. Thus, whereas shading alone had little effect on evaporation, a 50 per cent. reduction in evaporation loss was achieved by minimizing the movement of air over the snow surface. Stands of trees and other vegetation are known to have a pronounced stilling effect on the atmosphere near the ground surface. Further studies are needed to determine the amount of water lost by evaporation of snow during the entire season of snow accumulation and melting and the extent to which manipulation of the plant cover on the western watershed lands will decrease this loss and thereby increase ground water and streamflow.

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SCIENTIFIC BOOKS

VERTEBRATE PHOTORECEPTORS

Vertebrate Photoreceptors. By SAMUEL R. DETWILER. 10+184 pp. New York: The Macmillan Co. 1943. $4.00.

FROM time to time a book appears that contains precise technical information, presented so simply, clearly and interestingly that it makes good reading for scientist and layman alike. Such is this latest publication in the series of Experimental Biological Monographs. As the title suggests, the author has largely limited his presentation to the structure and activities of the visual and pigment cells of the retina. By so doing he does not invade the field covered by the intensive treatise of Polyak ("The Retina," 1941); there is, likewise, only partial duplication of some of the topics more exhaustively treated by Walls ("The Vertebrate Eye," 1942). Professor Detwiler, though presenting no small amount of detailed information, aims rather at the biologist who is not professionally concerned with the photoreceptive apparatus but who wishes to know its present status as an adaptive visual-mechanism. Other beneficiaries are the non-biological scientist with catholic intellectual interests and the clinical ophthalmologist.

The first 59 pages are devoted to pure morphological description. In them the author presents the background-material necessary to an understanding of the rest of the monograph. After a preliminary chapter on the plan of the vertebrate eye as a whole, the organization of the retina is described. Here the reader may obtain a digest of the far-reaching and revolutionary concept of Polyak concerning the types of neurones encountered in the primate retina, their synaptic relations and the paths taken by retinal impulses. The next chapter deals with the structure

of visual cells, including a discussion of the difficulties encountered in assigning certain aberrant types to the rod or cone category, and the criteria (advanced by Kolmer through the use of differential staining) to be employed in the proper identification of these elements. A final morphological chapter covers the development of the retinal elements, in which the differentiation of the visual cells receives major attention. The rod and cone are considered to be the products of divergent specialization from a common prototype; consequently, arguments are marshalled against the claim that cones are specialized rods or that cones are rods arrested in development.

From this point on, the treatment shifts from straight morphology to functional correlations and interpretations. Three chapters discuss some of the more general adaptations that are seemingly useful. One of these chapters cites the correlations that exist between the kinds and ratios of visual cells found in any retina and the habits (diurnal, nocturnal or both) of that animal. Somewhat disappointing is the failure to come to grips unequivocally with the issue raised by Walls's provocative claim that cones have transmuted into rods in many nocturnal animals. A second chapter gives a résumé of the capacities of rods, cones and retinal pigment to undergo positional changes in light and darkness. Some other influences, such as temperature, are included as well. The final chapter in this group reviews the possible usefulness of positional shifts in the visual receptors and retinal pigment in the furthering of efficient vision. No one theory is deemed sufficiently inclusive to explain all the responses to light, temperature, etc., on an adaptive basis. The author fails to present what, in the opinion of the reviewer, is the most conclusive evidence showing how the several photomechanical responses to bright and dim light in fishes correlate with the duplicity theory of vision.

The remaining four chapters are devoted to more specialized topics. Two consider the arrangements by which visual acuity is attained, particular attention being paid to the significance of the fovea. The correlation between foveal development and the ability to perform extensive ocular movements is accepted, but the author concludes that conjugate movements, binocular vision and partial decussation of the optic tracts are not necessarily implied. He also demurs against Elliott-Smith's view that the presence of a macula has led to marked evolutionary advances in the portions of the brain concerned with vision. Walls's recent interpretation of the fovea as a mechanism for enhancing the resolving power of the retina, not for mere optical thinness and homogeneity, is given the sympathetic consideration that this important concept deserves.

The two final chapters center about the retinal photopigments. The fundamentals emerge through an exposition of the properties of rhodopsin and the less familiar porphyropsin of the rod and of iodopsin of the cone. The relations of these carotenoid derivatives to the vitamins A (as both precursor substances and decomposition products) are reviewed on the basis of Wald's recent, important disclosures. The author attempts to make tangible the spectrophotometric analyses concerning these substances by identifying the Kolmer droplets, seen abundantly alongside dark-adapted rods, as retinene —the decomposition product intermediate between vitamin A and visual purple. In conclusion there is a timely digest of the dependence of vision on vitamin A, of the effect of its deficiency on physiological thresholds (night blindness), of the breakdown of rods following prolonged avitaminosis A and of the capacity of rod repair after a return to an adequate diet.

This monograph carries 110 excellent illustrations, several extensive tables, a recapitulation, a valuable bibliography against which textual statements may be checked, and both an adequate author and subject index. It contains some original data, of use as source material to the specialist. The scientific world is placed in debt to Professor Detwiler for having produced so readable, stimulating and authoritative a book in a field that has been both enlarged and quickened through his own investigative activities.

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RADIOLOGY

Physical Foundations of Radiology. By OTTO GLASSER, EDITH H. QUIMBY, LAURISTON S. TAYLOR and J. L. WEATHERWAX. x+426 pp. 95 figures. 55 tables. New York and London: Paul B. Hoeber, Inc., Medical Book Department of Harper and Brothers. 1944. $5.00.

THE applications of physics to the field of radiology have grown rapidly within the last decade. The subject is assuming a place of increasing importance in the field of radiology.

The student in radiology, as well as the established radiologist who wishes to study this phase of the subject, will find this book relatively easy and profitable reading. The four eminent research workers and well-known teachers have pooled their experiences to produce this fundamental and non-mathematical work. The text is not a source book of theoretical radiologic physics, for it contains very little mathematics. A

bibliography is included at the end of each chapter for those wishing more detailed information.

Chapter I presents the historical milestones in radiology from the discovery of roentgen rays to the construction of the 100 million volt betatron. In the 14 pages of Chapter II a very brief but fundamental outline is given of the concepts of the structure of matter. The nature of radiations is covered in Chapter III (7 pages) and in Chapter IV the fundamentals of electricity and magnetism are given in the simplest terms. High voltage generators in Chapter V (26 pages) starts with rectification, including all the general types. It continues with short descriptions of electromagnetic and electrostatic supervoltage generators and ends with the Kerst betatron. Chapter VI (8 pages) dealing with roentgen ray tubes is perhaps too short. The next two chapters deal with the production and nature of x-rays and the interaction of radiation and matter. These chapters contain fundamental information which greatly helps in the understanding of the action of x-rays, both in their biologic action and in diagnostic procedures, the latter being considered in Chapter IX. The measurement of x-ray quantity and quality is excellently taken up in the next two chapters (64 pages). The principle of ionization chambers of various kinds and their use are well described. Diagrams, charts, curves and tables help to clarify this material. Of great interest is the chapter on tissue dosage (33 pages). Next comes radioactivity, and measurement of gamma ray quantity. Neutrons and artificial radioactivity are coming subjects of inevitable importance to the radiologist. Some of the fundamentals are presented in Chapter XV (20 pages). Dosage in gamma-ray therapy is discussed in Chapter XVI, with charts and tables; and biologic reaction to radiation in Chapter XVII. The next chapter, dealing with roentgen ray and radium therapy records, is extremely worth while as it teaches the therapist to think accurately and it is a step toward uniformity of all therapy records. The last chapter (XIX) deals with roentgen ray and radium protection and is a subject that all radiologists should constantly keep in mind.

In the Appendix, 12 depth dose tables are given covering radiation from 100 kv inherent filter only, to 200 kv, 2.00 mm cu. The volume ends with a name index and a suject index.

The book is practical in nature, covering material needed by the practicing radiologist.

George C. Henny

SPECIAL ARTICLES

INHIBITION OF GROWTH OF MYCOBACTERIUM TUBERCULOSIS BY A MOLD[1]

A culture of tubercle bacilli which had been stored in the ice box was found to be overgrown by a green mold. Subcultures of this mold on other cultures of tubercle bacilli showed rapid and luxuriant growth at room temperature but no growth at 37° C. On cultures of tubercle bacilli the mold grew faster and sporulated earlier than it did on similar sterile media.[2] Growth of the mold occurred on suspensions of tubercle bacilli in saline solution, although no growth of it occurred in the saline solution alone. The mold is as yet unidentified but probably belongs to the Penicillium group.

Experiments were carried out to determine the effect, if any, of this mold or substances produced by it, on tubercle bacilli. Several of these experiments are presented in this preliminary report.

Effect of the mold on Mycobacterium tuberculosis: Suspensions of tubercle bacilli were made in saline solution in concentrations of 3 mgm tubercle bacilli per ml. Recently isolated, rapidly growing strains of human type tubercle bacilli were used. Suspensions of the mold were made by grinding it in a mortar with saline solution. The pH of the mold suspension varied from 6.5 to 7.8. 5 ml of tubercle bacilli suspension (15 mgm of organisms) were added to 5 ml of the mold suspension and to 5 ml of saline solution as a control. The mixed suspensions were allowed to stand from 24 to 48 hours at room temperature. At the end of this period smears and cultures were made on three culture tubes and 1 ml of the mold suspension was injected into the left groin of a guinea pig.

Thirteen experiments of this type have been carried out with but one culture tube showing any growth of tubercle bacilli. In that instance only one colony was observed, whereas the control cultures grew luxuriantly. The other twelve experiments gave entirely negative results. Although no growth was observed on these tubes, acid-fast bacilli were still present in smears even after several months' incubation of the tubes. Likewise, acid-fast bacilli were seen in smears of the mixed suspensions.

Seven of the thirteen experimental guinea pigs are alive and have negative tuberculin tests, whereas all the control animals except one have died of tuberculosis. Six of the experimental animals died of tuberculosis. The results of two experiments of this type are shown in Table 1.

[1] From the Edward J. Meyer Memorial Hospital and the Department of Medicine, University of Buffalo School of Medicine, Buffalo, N. Y.

[2] F. G. Petrik, *Am. Jour. Clin. Path.* (*Tech. Supl.*), 8: 134, 1938.

In a second type of experiment, the mold was grown at room temperature on cultures of tubercle bacilli. The controls were cultures of tubercle bacilli of the same strain and were kept under the same conditions. At the end of two weeks, suspensions were made of the controls and of the mold and tubercle bacilli tubes by grinding with saline solution in a mortar. Cultures, smears and guinea pig injections were done after the suspensions had stood for 24 hours as in the previous experiments. Eleven such experiments have been done. In no instance have tubercle bacilli grown in the cultures of suspensions of mold and tubercle bacilli while the control cultures have all grown rapidly. As in the previous experiments, acid-fast organisms were found in all the smears. Ten of the experimental guinea pigs are alive and well; all these have negative tuberculin reactions. One animal died of an acute enteritis on the 88th day and showed no tuberculosis. The results of two such experiments are shown in Table 2.

TABLE 1

No.	Date	Cultures	Guinea pigs
41	3/21/44	− − −	living 7/21/44
58	3/21/44	− − −	living 7/21/44
control	3/21/44	+ + +	died at 53 days (Tbc at autopsy)
63	4/7/44	− − −	died at 99 days (Tbc at autopsy)
control	4/7/44	+ + +	died at 43 days (Tbc at autopsy)

TABLE 2

No.	Date	Cultures	Guinea pigs
14	2/26/44	− − −	living 7/21/44
control	2/26/44	+ + +	dead at 41 days
15	3/3/44	− − −	living 7/21/44
control	3/3/44	+ + +	dead at 84 days

Effect of the mold on Tuberculin and P.P.D.: The mold grew well on tuberculin in dilutions as high as 1:10,000 in saline solution. It also grew on dilutions in saline solution of P.P.D. (Purified Protein Derivative of Tuberculin), in concentrations of 0.05 mgm and 0.0002 mgm P.P.D. per ml. No growth occurred on saline controls. Solutions of tuberculin and P.P.D. upon which the mold had grown no longer produced positive skin reactions in guinea pigs which had been previously injected with tubercle bacilli, although control solutions of tuberculin and P.P.D. made in the same manner and left at room temperature for the same length of time produced typical skin reactions in the same animals.

Suspensions of the mold, prepared as described above, inactivated 1:100 tuberculin in two hours when left either at room temperature or at 37° C. Supernatant fluid obtained after centrifugation of the mold suspension also inactivated 1:100 tuberculin. When the supernatant fluid was passed through a bacterial filter (E. K. Seitz), the filtrate did not inactivate tuberculin.

Experiments using fluid media, similar to that used for the production of penicillin, upon which the mold had been grown for 8 to 15 days, have shown no effect on tubercle bacilli or on tuberculin. *Staphylococcus aureus* grew on solid media upon which the mold had been grown and had been removed. Therefore it is believed that the substance produced by this mold is not similar to penicillin.

Experiments using extracts of the mold and of the supernatant fluid are in progress at the present time.

In 1910 Vaudremer[3] observed that tuberculin, when added to filtered extracts of molds such as *Aspergillus fumigatus* and *Penicillium glaucum*, loses its activity. Furthermore, he observed that tubercle bacilli were modified by maceration in extracts of these fungi. Machado[4] noticed that tubercle bacilli lost their acid fastness after three months' incubation in a culture of an unidentified mold. Smith and Emmart[5] have shown that aqueous solutions of ether extracts of Raulin-Thom culture media of *Penicillium notatum* exhibited *in vitro* at certain concentrations, marked bacteriostatic activity against tubercle bacilli, although other preparations had little or no activity.

Conclusions: Suspensions of a mold which probably belongs to the Penicillium group inhibit the growth of tubercle bacilli. Suspensions of this mold inactivate tuberculin in two hours. Filtrates of these suspensions have no effect on tuberculin.

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ALBERT C. REKATE

IODINATION OF INSULIN

IN an earlier report it was pointed out that the presence of a sufficient concentration of phosphate buffer salts at moderately elevated temperatures greatly increases the rate at which tyrosine reacts with certain oxidants.[1] This characteristic increased activity was found to be associated with the phenolic hydroxyl group. In view of the importance which has been attributed to this group, in regard to the physiological activity of a number of hormones, enzymes and proteins of disease this activity has been employed in correlating physiological and chemical activity and has been applied as a means of readily iodinating proteins or introducing other groups.

[3] A. Vaudremer, *Ann. Inst. Pasteur*, 24: 189, 1910; "Le Bacille Tuberculeux," Les Presses Universitaires, Paris, 1927.

[4] A. Machado, *Compt. rend. Soc. biol.*, 96: 484, 1927.

[5] M. I. Smith and E. W. Emmart, *Pub. Health Rep.*, 59: 417, 1944.

[1] D. E. Bowman, *Jour. Biol. Chem.*, 141: 877, 1941.

Insulin was employed in the earlier phases of this study, since it contains considerably more tyrosine than do most proteins, its biological activity depending in part upon the phenolic hydroxyl of this amino acid. The object of the present preliminary note is to briefly describe some of the findings regarding relative reaction rates and solubilities associated with the iodination of insulin and other proteins. Other phases of the study will be described elsewhere.

A photoelectric photometer was used in observing relative iodination rates and degrees of turbidity. In some instances described here iodine was added to the experimental material and the depth of color observed (in the presence of starch) before phosphate buffer was added. The rate of iodine utilization was then followed to the point of complete decoloration. In other cases the relative turbidity resulting from the presence of the buffer and starch in the experimental solution was first noted and then the initial degree of color and the rate of decolora-

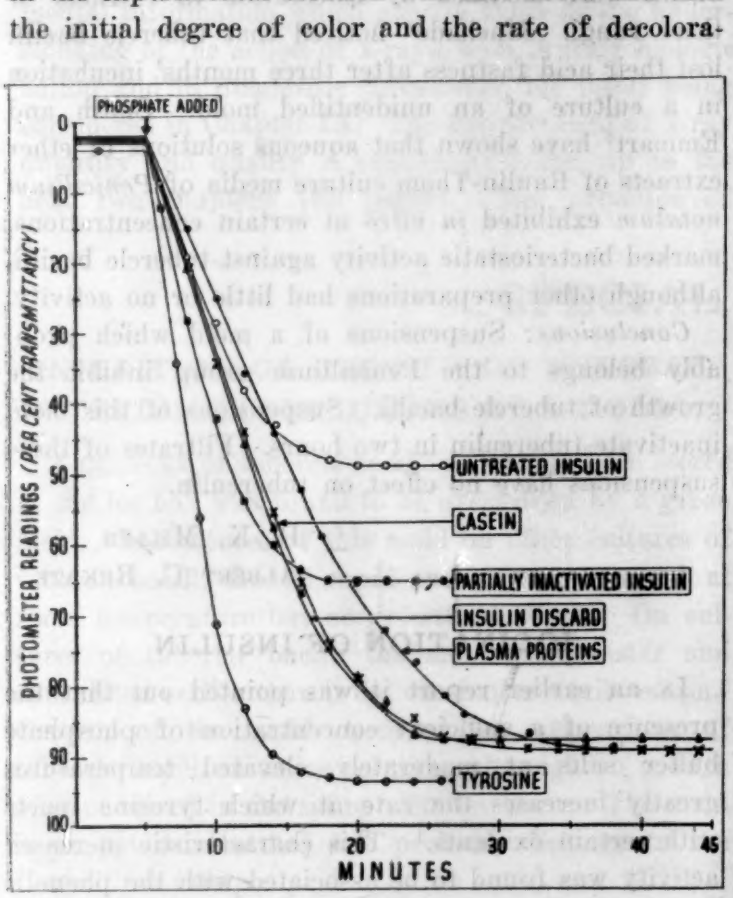

FIG. 1

tion were observed following the addition of iodine. The 0.001 N iodine used in these observations was freshly prepared from potassium iodate and potassium iodide in the presence of a moderate excess of hydrochloric acid. The starch solution consisted of 0.2 per cent. soluble starch according to Lintner. The solution was prepared by gently boiling for five minutes before diluting to volume. In some cases the temperature of the reaction medium was maintained at 38° C., while in other cases it was 50° C. The phosphate buffer solution consisted of a 0.8 M solution prepared according to Sorensen.

Employing 3 cc of an aqueous solution containing 0.1 mg of tyrosine with 3 cc of the starch, and 2 cc each of the iodine and the buffer solution (pH 5.9) it was found that a constant starch-iodine color remained before the phosphate was added. The rapid utilization of the iodine at 38° following the addition of the buffer is represented in Fig. 1. From the same figure the rapid reaction of 2 mg of amorphous insulin[2] under similar conditions is apparent. It may be observed that the iodinated insulin is less soluble under these conditions, giving the solution a decided turbidity.

On the other hand, it will be seen that after heating some of the same insulin in acid and alcohol the iodinated form was decidedly more soluble than the untreated insulin but still considerably less than inert proteins such as casein or plasma proteins. This treatment of the insulin was carried to the point at which the biological activity was decreased to about 50 per cent. of the original.

It is of interest to note that the curve representing the iodination of insulin discard, the last fraction which is discarded in the commercial preparation of insulin, resembles those of the inert proteins.

The reaction with crystalline zinc insulin resembles that of the untreated amorphous insulin. Protamine zinc insulin was also used, although a higher pH was employed in this case. Relative differences in the rates of iodination of insulin and the inert proteins are most apparent when smaller quantities of material are used and excess potassium iodide is employed in the preparation of the iodine solution.

By adding the iodine after the phosphate salts it is possible to more specifically estimate the change in turbidity accompanying the iodination. From Table 1 it will be observed that iodination amplifies the

TABLE 1

Amount of insulin	Per cent. transmittency	
	Before iodination	After iodination
40 units	10.0	96.5
32 "	8.0	78.7
24 "	4.8	51.5
16 "	4.0	34.0

insolubility of the insulin under the conditions employed. In this series the original procedure was also altered by increasing the temperature to 50° C. and adjusting the sensitivity of the photometer in such a way as to narrow the range, approximately doubling all the readings. It may be observed that a reasonably close correlation exists between the concentration of the insulin and the turbidity following the iodination. In this latter series commercial insulin containing 0.2 per cent. phenol was used as

[2] We are indebted to Eli Lilly and Company for the various insulin preparations and the insulin discard.

the source of material. It was found that the added phenol could be completely extracted with ether without interfering with the subsequent insulin reaction. Deviation between concentration and turbidity before iodination was especially observed with the partially inactivated insulin. The characteristics of the iodination curves obtained in this manner were relatively constant and reproducible.

The iodination of insulin or other proteins also proceeds rapidly in the absence of starch. However, uniformity of results and the stability of the suspension of iodinated proteins were found to be improved in the presence of starch prepared as described.

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TRACER STUDIES WITH RADIOACTIVE SODIUM IN PATIENTS WITH PERIPHERAL VASCULAR DISEASE[1, 2]

IN patients suffering from peripheral vascular diseases, the circulation time, volume of blood circulating in the extremities, and relation between plasma and extravascular fluid in the extremities may be altered. A study of these should be of diagnostic and prognostic value. The employment of radioactive sodium as a tracer substance in the blood is well suited to this purpose. It is easily prepared in the cyclotron, has a rather short half life (14.8 hours) and emits radiations which are readily detected. The injection of a few cu cm of normal saline into the blood stream can have no physiological effect, if the accompanying dose of radiation is insignificant. In the experiments here reported, this was the case.

The radioactive isotope is prepared by bombarding sodium metaborate in the cyclotron with deuterons. The metaborate containing the active atoms is dissolved in water, acidified with hydrochloric acid, and treated with methyl alcohol. The resulting methyl borate and water are driven off by heating, leaving sodium chloride. This is prepared in sterile solution in the desired concentration for injection.

When this material is injected into a vein it is carried throughout the vascular system, and the time required for it to reach a foot can be determined by placing a Geiger-Müller counting tube at the extremity and timing the interval between injection and audible registration by the counter. Since there is constant interchange of sodium between plasma and extravascular fluid, the amount of radio-sodium in the foot will increase until equilibrium is established between these two. The manner in which this equilibrium is built up depends on the volume of blood traversing the region per unit time, and on the relation between intra- and extra-vascular space; these are related to the normal or diseased condition of the foot. By following the counting rate during a period after the administration of the isotope, information can be gained regarding this build-up.

The experimental procedure is as follows: The syringe containing 60–200 micro-curies of radio-sodium in 3–10 cu cm of saline is held close to the site of the injection, the Geiger-Müller tube, in a lead housing with a thin aluminum window, is placed against the sole of the patient's foot, and the scaling device on the counter adjusted so that 1 or 2 clicks are heard each 5 seconds. The injection and the electric stop-clock are started simultaneously, and counts recorded every 5 seconds, the time of the end of the injection also being noted. When the material reaches the foot, the number of clicks per 5 seconds increases definitely and sharply; the 5-second counting is, however, carried on for about a minute longer, to be sure that no erratic background has been mistaken for the arrival of the material. After this, the counting is carried on minute by minute as the build-up proceeds. After 10 or 15 minutes the counter is shifted to the other foot. Subsequently measurements are made at various regions of the legs, hands, etc., with frequent return to the feet.

Circulation times, arm to foot, have been determined in 35 individuals; the average value was 45 seconds, but the range was considerable. The highest was 90 seconds, in an elderly diabetic, arteriosclerotic woman who was fibrillating at the time of the test. The lowest was 15 seconds, in a young man in a highly nervous state, with a pulse of 100, suffering from scleroderma. In ten individuals considered to be normal as far as circulation was concerned, eight fell between 45 and 55 seconds; the other two were 60 seconds. Five cases of thromboangitis obliterans were all below 35 seconds. Seven arteriosclerotics showed a range between 30 and 80 seconds; it may be possible later to correlate circulation time with stage of disease. Four cases with ulceration and inflammation (three diabetics) showed times below 35 seconds.[3]

Probably more promising than circulation time as a clinical aid is the curve of equilibrium build-up. Fig. 1 shows data for the first 45 minutes for six normal individuals, five men and one woman, whose weights varied from 50 to 75 kg. (No adjustment is

[1] A preliminary report.

[2] From the Departments of Radiological Research and Surgery, College of Physicians and Surgeons, Columbia University, with the aid of a grant from the Lilla Babbit Hyde Foundation.

[3] Hubbard, Preston and Ross have employed radio-sodium in a somewhat similar manner to determine circulation time in infants, although the present authors were unaware of this when they commenced their study. See *Jour. Clinical Investigation*, 21: 613, 1942.

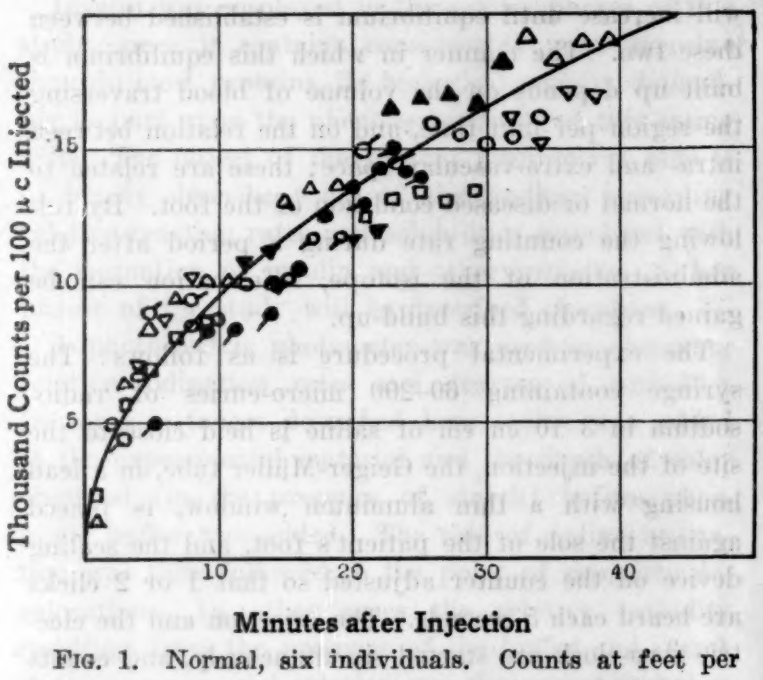

FIG. 1. Normal, six individuals. Counts at feet per 100 micro-curies of radio-sodium injected. Solid points, right foot; open points, left foot. Average curve drawn through experimental data.

made for variation in weight. Only alternate minutes are recorded, to prevent crowding the chart.) Solid points indicate counts for the right foot, open ones for the left, per 100 micro-curies of radio-sodium injected. All values fall within ±15 per cent. of an average curve. During the next hour the values increase by about 25 per cent., and in the following 24 hours pos-

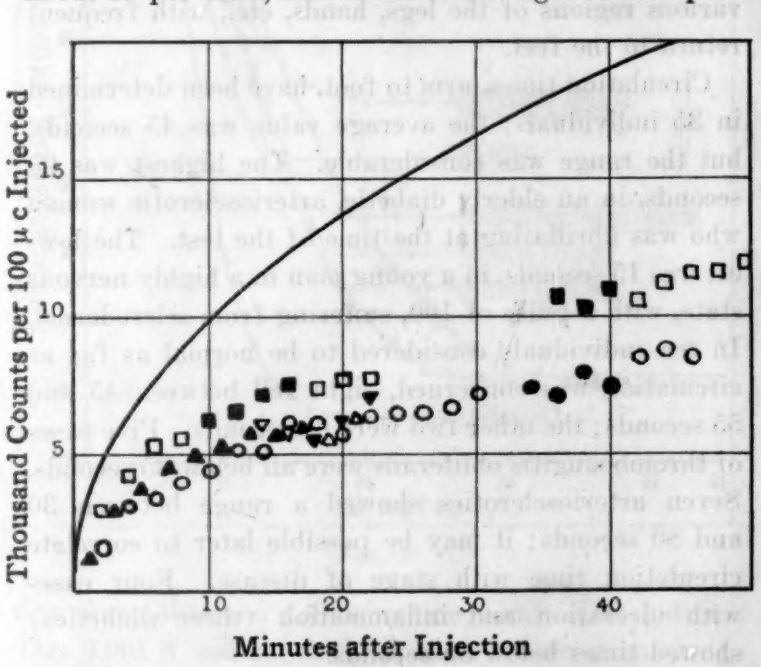

FIG. 2. Scleroderma and Raynaud's disease. Normal curve from Fig. 1; experimental points all well below it.

sibly 10 per cent. more (allowance, of course, being made for radioactive decay). Excretion in the first 24 hours is not more than 5 per cent., and probably less. Measurement on total urinary excretion in two normal individuals gave 2.5 per cent. of the injected radio-sodium in the first 18 hours.

In some cases of various types of peripheral vascular disease, as diagnosed clinically, the curves fell within the normal range. In others, however, there were marked differences. The thromboangitis obliterans cases all fell near the lower limits of the normals, as did most of the arteriosclerotics. Further study may lead to some way of differentiating among these. On the other hand those with diabetic gangrene, scleroderma and frostbite ("immersion foot") all fell well below the limits of the normal group. In Fig. 2 the heavy line shows the average normal curve; the points are for three cases of scleroderma and one of Raynaud's disease. This last (the squares) was rather surprising, for the patient's symptoms were confined to her hands. In Fig. 3, the heavy line is again the

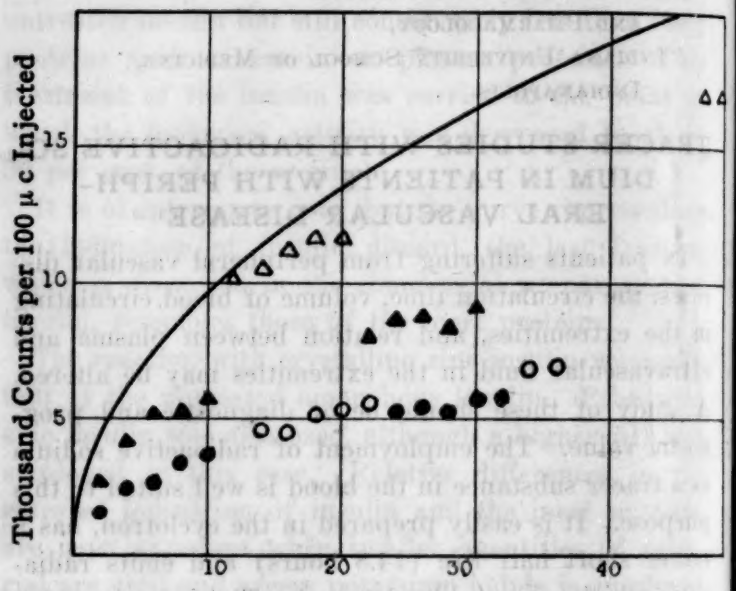

FIG. 3. "Immersion Foot." Normal curve from Fig. 1. Case indicated by circles had both feet affected, case indicated by triangles had left foot nearly normal.

normal curve; the points represent two cases of immersion foot. In the case indicated by the circles, the feet appeared normal, except that they were cold to the touch, and the patient had been certified as fit for active duty. He complained of pain on standing or walking and especially on being chilled; the feet were about equally affected. The case indicated by the triangles had a right foot much worse than the left. The solid points are for the right foot; the open ones for the left, which was almost normal. It appears that a test of this type would make possible the differentiation between cases which had recovered and those which had not. The study should be extended to the acute type of frostbite suffered by aviators in short exposures to very low temperatures, in contrast to the long exposures at not such low temperatures but with accompanying soaking endured by those drifting in open boats for several days.

Differential reactions between the two feet have been observed in a number of individuals with various com-

plaints, and may be useful as a guide to treatment. In Fig. 4, the circles are data for a woman with dia-

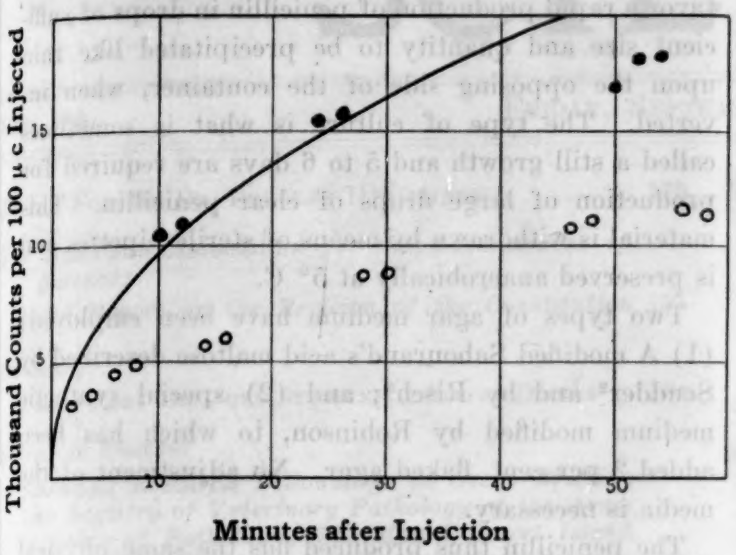

FIG. 4. Diabetes. Normal curve from Fig. 1. Right foot normal, left gangrenous. Subsequently amputated, with poor wound healing.

betic gangrene in the left foot, no symptoms in the right. The solid circles, for the right foot, fall within normal limits; the open ones for the left, are low. The left foot was subsequently amputated, with poor wound healing. In other cases the region of the leg at which normal counting occurred has been used satisfactorily as a guide to position of amputation.

The interpretation of the type of count which increases more slowly than normal, but eventually, even after several hours, reaches the normal level, is probably concerned with the condition of the circulatory system. In those cases in which the count does not come up to normal after several hours, the explanation may be different and may have to do with actual change in the so-called "sodium space" in the foot.

Sodium space has been determined by Kaltreiter and his associates and by others, by injecting radiosodium as in the present work and then withdrawing blood at a certain time subsequently, and determining the ratio of counts per cu cm of serum to counts for the total material injected, under standard conditions.[4] Further studies along this line are being carried out, for patients with vascular disease.

Up to the present time fifty individuals have been studied, some in more detail than others. In each disease group only a few cases are available; however, the data have already proved of value in diagnosis and prognosis, and it is evident that further work is desirable.

An application of the method which has not as yet been employed to any extent is as an evaluation of therapeutic procedures. If a patient is tested before treatment is instituted and at intervals while it is being carried out, any change either for the better or worse should be indicated. Repetitions of the test at intervals of a few weeks would be entirely safe, since the amount of radiation dose for each test is so small.

The authors wish to express their indebtedness to the Radiation Laboratory of the Department of Physics of Columbia University, for providing the Geiger-Müller counting apparatus and for the preparation of the radioactive sodium.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A DRY ICE FREEZING UNIT FOR ROTARY MICROTOMES

TISSUE sections cut from the frozen state are being utilized in an increasing number of techniques, but the equipment necessary for cutting such sections is not always available. The methods in common use require either a sliding microtome or a specially designed "freezing" microtome. However, the rotary microtome is the only kind available in many laboratories, and although it is generally considered to be unsuited for cutting frozen sections, it may be quite satisfactorily adapted for this purpose by the use of the device illustrated in Fig. 1.

This consists of a metal box made to conform to the shape of the object clamp of the microtome in which it is to be used, but about 2 mm smaller on all sides to allow for insulation. (The dimensions shown are suitable for No. 818 and No. 820 Spencer microtomes.) One end is made from a piece of sheet copper, to the outer surface of which is soldered a metal object holder about 2 mm in thickness and large enough to accommodate the desired specimens. The face of the object holder is grooved to provide for the firm attachment of the specimen and its entire back surface must be uniformly fused to the end of the box to allow for rapid and efficient heat transport. The sides of the box are made from a single sheet of copper bent to the same size and shape as the end and soldered to it. The other end is made of asbestos board, bakelite or other insulating material. It fits tightly into the open end of the box and should have a small handle to allow easy removal. The entire unit, except the surface of the object holder, is insulated by cementing on a layer of asbestos paper and then covering this with a layer of hard-surfaced paper and several coats of waterproof varnish.

[4] N. L. Kaltreiter, G. R. Meneely, J. R. Allen and W. F. Bale, *Jour. Exper. Medicine*, 74: 569, 1941.

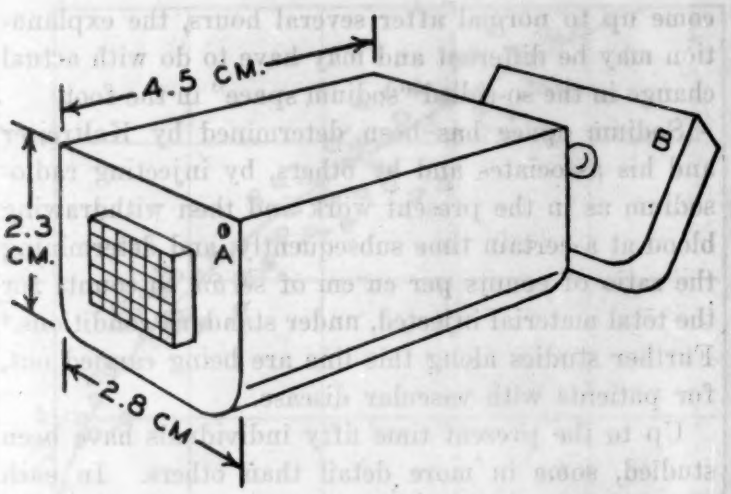

FIG. 1. Freezing unit without insulation. A = Hole for escape of CO_2, B = Removable end.

In using this unit, the case is filled with dry ice (about 20 g) and a piece of tissue, either fresh or infiltrated with gum or gelatin, is placed on the object-holder, to which it adheres almost instantly. Freezing may be hastened by inverting the unit after the tissue is firmly attached or by placing small pieces of dry ice around the tissue. Pieces 10 mm or more in thickness may be frozen. When the tissue is completely frozen, the dry ice is replenished and the unit inserted in the microtome. The heat transfer within the container is so rapid that it is not necessary to keep the dry ice pressed against the freezing surface. The tissue will remain frozen until all the dry ice is gone, 15–20 min. If more time is required, the unit may be easily refilled before the block has thawed.

This unit provided excellent sections of large feather germs, which are difficult to section by any method, and of such soft tissues as liver, kidney and spleen. Soft tissues could be cut at 20–30 microns without fixing or embedding, and excellent sections as thin as 5 microns could be cut after infiltration with a gum arabic solution. This attachment is easily made from materials available anywhere (other metals might be substituted for copper, although it is important to keep the thermal conductivity as high as possible), it is simple and economical to operate, and it produces sections comparable to those obtained with other freezing devices. It should be adaptable to all work except where very large pieces of tissue must be cut.

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A DROP METHOD OF PENICILLIN PRODUCTION[1]

A NEW method of producing good yield of penicillin consists of culturing *Penicillium notatum* No. 5415 on a solid agar base containing constituents which favor a rapid production of penicillin in drops of sufficient size and quantity to be precipitated like rain upon the opposing side of the container, when inverted. The type of culture is what is sometimes called a still growth and 5 to 6 days are required for production of large drops of clear penicillin. This material is withdrawn by means of sterile pipettes and is preserved anaerobically at 5° C.

Two types of agar medium have been employed: (1) A modified Sabouraud's acid maltose described by Scudder[2] and by Risch[3]; and (2) special synthetic medium modified by Robinson, to which has been added 2 per cent. flaked agar. No adjustment of the media is necessary.

The penicillin thus produced has the same physical properties as were described by Fleming[4] for that which he discovered. It is lighter than chloroform, heavier than ether, soluble in water, transparent, clear and yellow. Penicillin isolated at this institution has been found bactericidal in 1–10 dilution and bacteriostatic in dilutions ranging from 1–200 through 1–600. Its unit value is greater than 6 units per cc.

Preparations of our penicillin have been used for topical application with very satisfactory results and dilutions range from 1–250 to 1–800 in sterile distilled water. The solution keeps satisfactorily in the wards if layered with solid paraffin and kept at ice-box temperature. Sterile oils lighter than the penicillin may also be used.

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